Ckov momentum scan data analysis

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Fermilab

Data taken

- Sep. 30, 2015
  - David Sanders' optics setting calculated from the magic spreadsheet;
    - Numbers were from DS=off mode (Actually it was on and the current was high: 447 A);
    - Goal was to sweep scan the pion momentum from 240 MeV/c to 340 MeV/c (p at the target)
- Oct. 7, 2015
  - To get more statistics for low momentum hits (the data taking was dominated by tracker calibration, so not as many triggers as expected);
  - Recalculated optics using the magic spreadsheet, with DS ON.

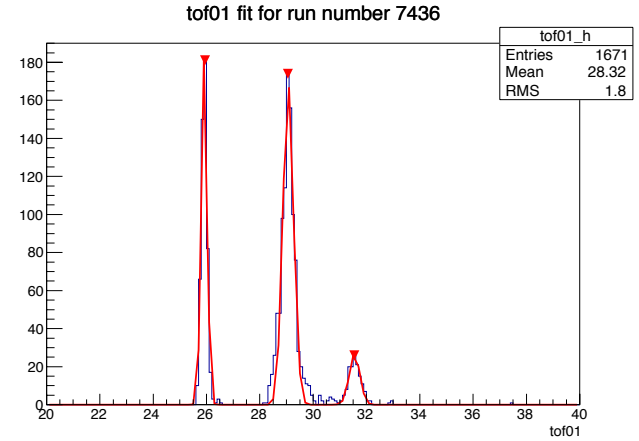
Analysis code

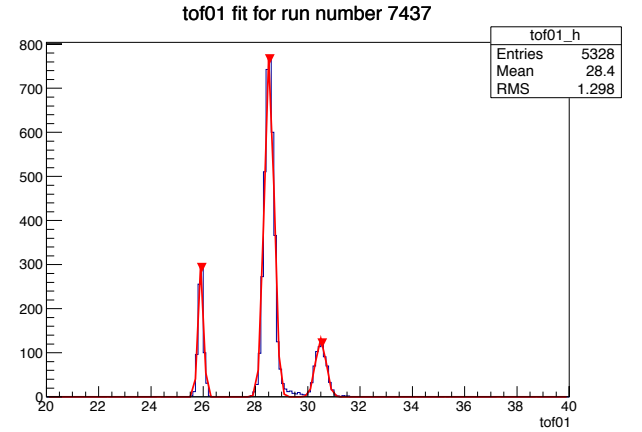
- Build on ROOT and MAUS Data structure
  - C++
  - “Semi-automated”:
    - Put reconstructed data in ROOT format in subfolders named by the run number;
    - Run executable with the run numbers as the wild card argument;
    - Get the number of photoelectrons yield v.s. momentum plot.

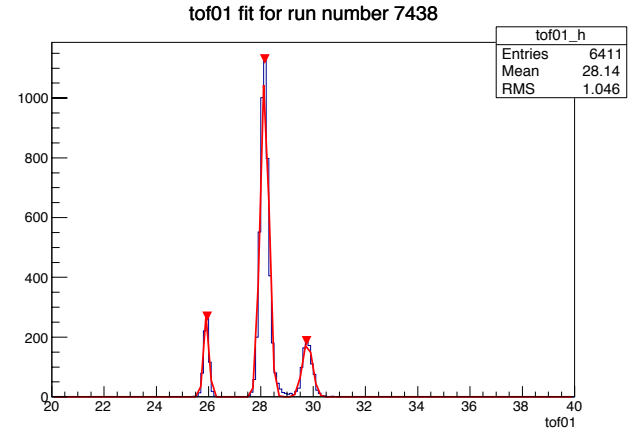
The data filter/cuts – fit TOF01

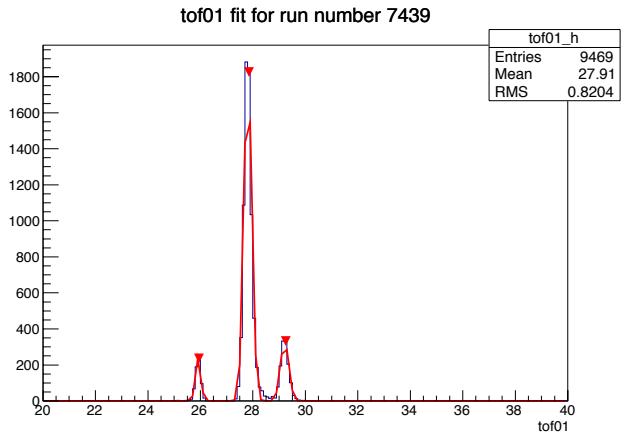
- The work flow:
  - Read data from the root file, keep only hits that produce 1 space point at TOF0 and TOF1, and produce non-zero pe at A and B (Basic filter) →
  - Get the time difference (time of travel) between the TOF1 and TOF0 hit, and the corresponding histogram. Fit the three (occasionally two) peaks with three Gaussian functions added together (9 parameters, *ROOT fit after peak finding*) →

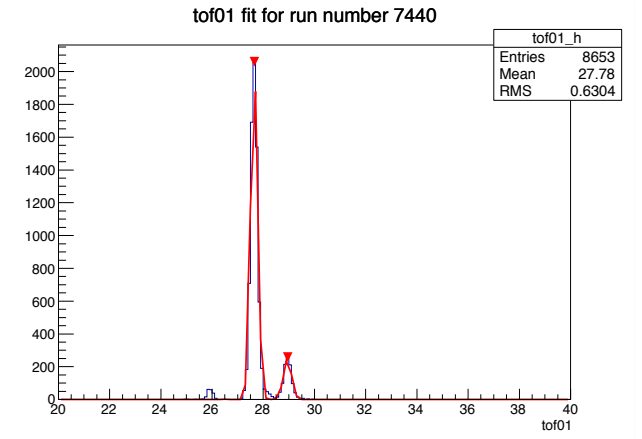
The data filter/cuts – fit TOF01

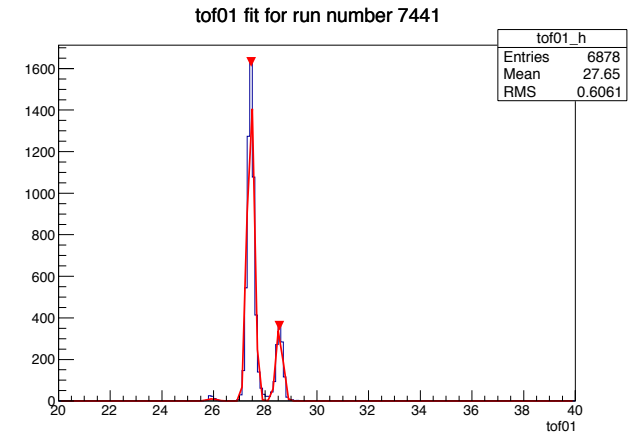








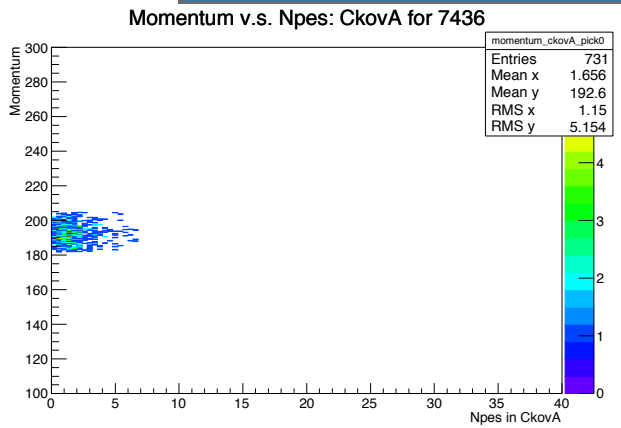


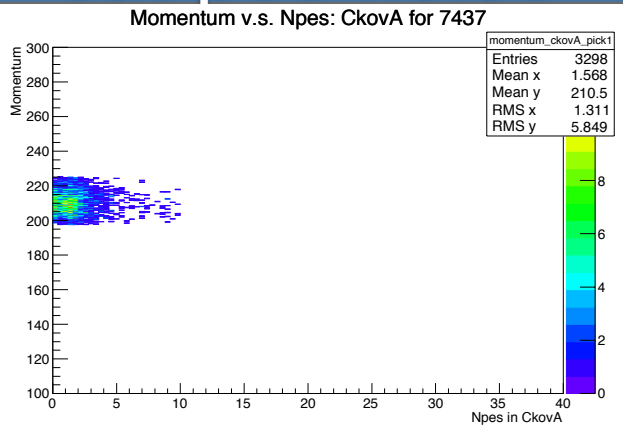


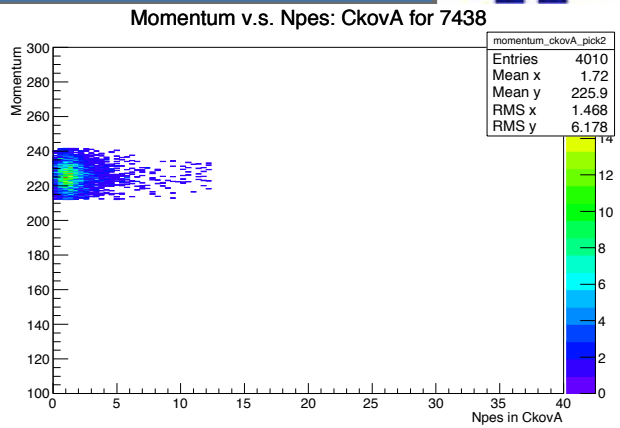
The data filter/cuts – Filter out PID and cut pes noise

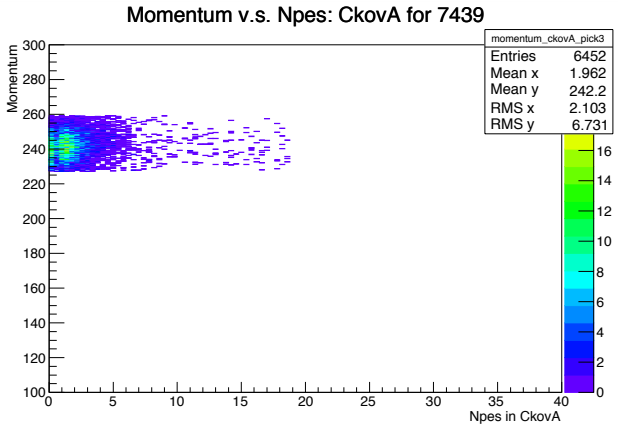
- The work flow (Cont'd):
  - For muons or pions, filter out hits that fall into the correct TOF01 range, based on the previous fitting →
  - Assuming straight tracks, calculate the momentum from TOF01 (not the complete path lengths with betatron oscillation, but the longitudinal distance between two TOFs) →
  - Get the histogram of # of pes, cut out the unreasonably large pes yield →

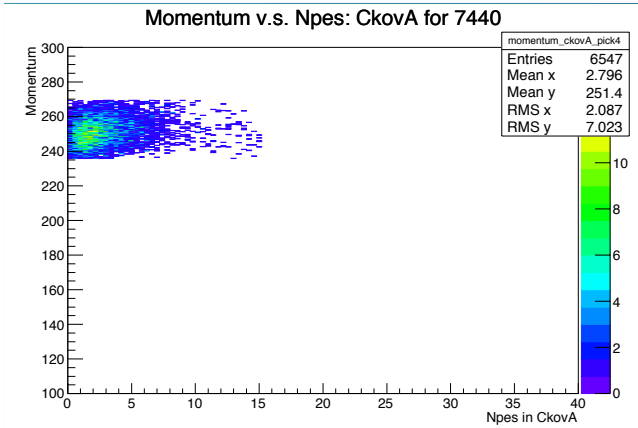
The data filter/cuts – Filter out PID and cut pes noise

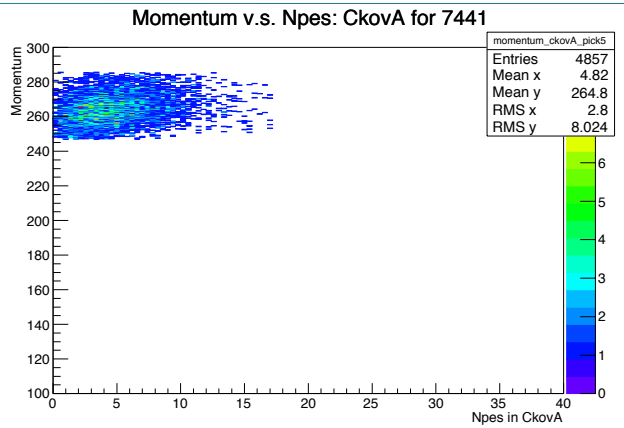








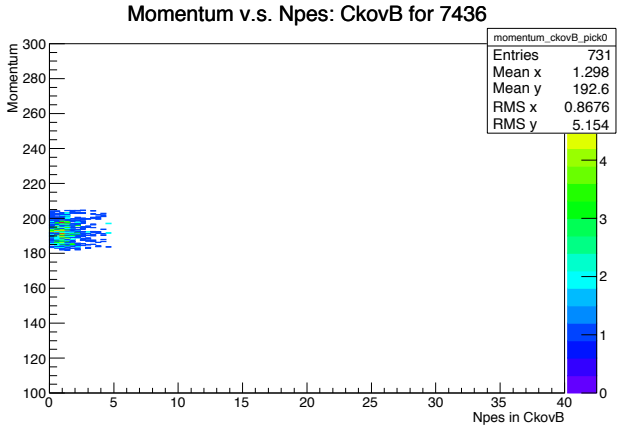


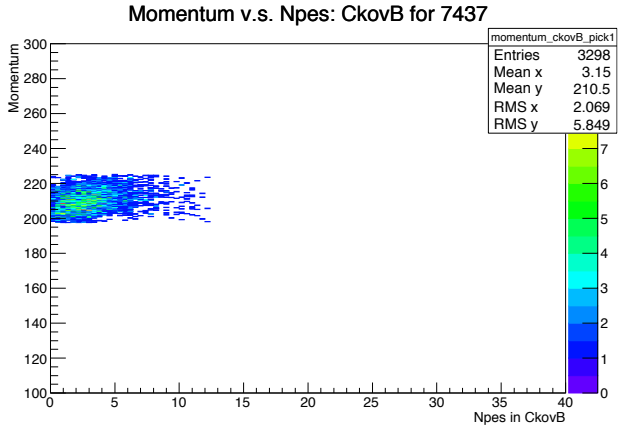


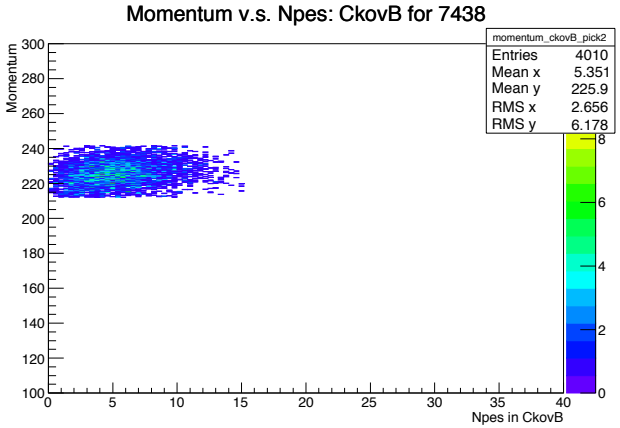
Take muons as the example

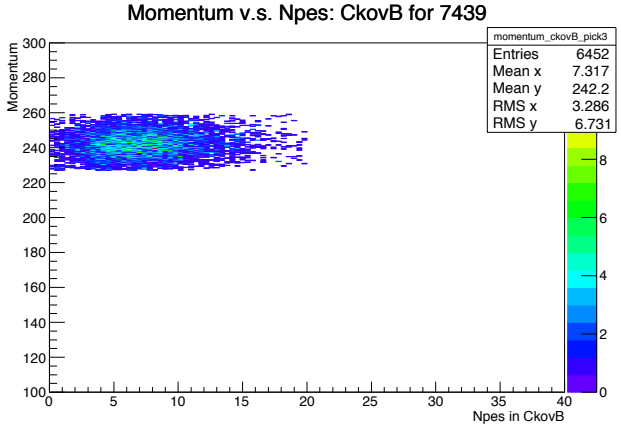
Ckov A

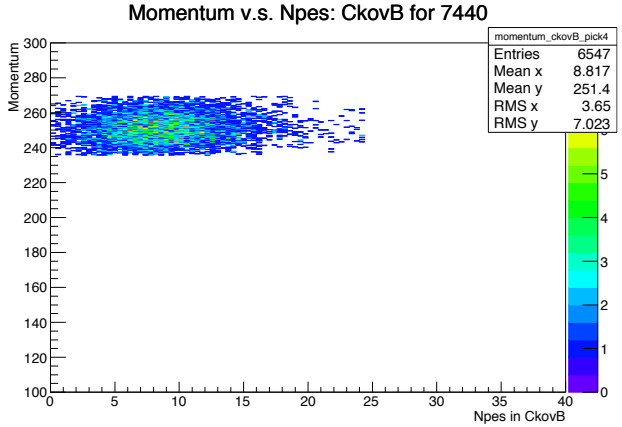
The data filter/cuts – Filter out PID and cut pes noise

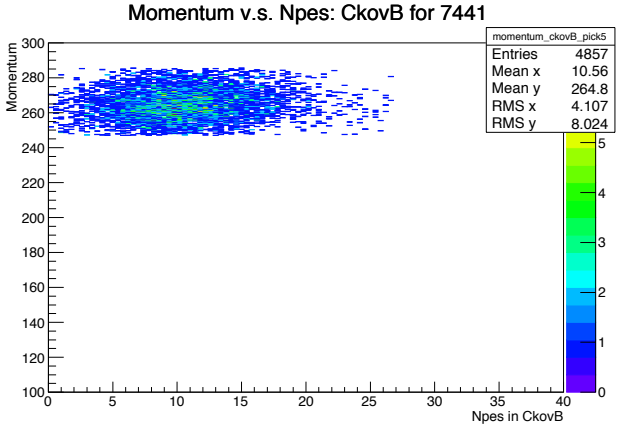








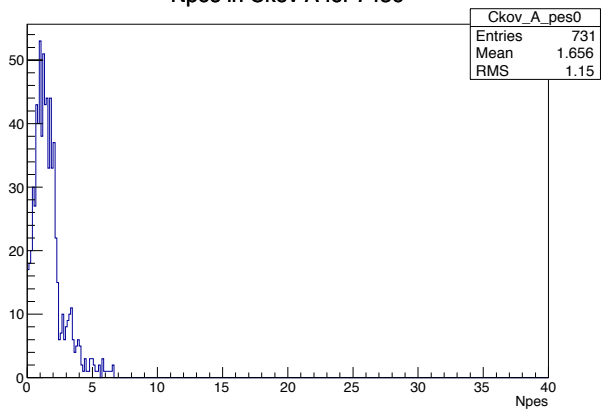




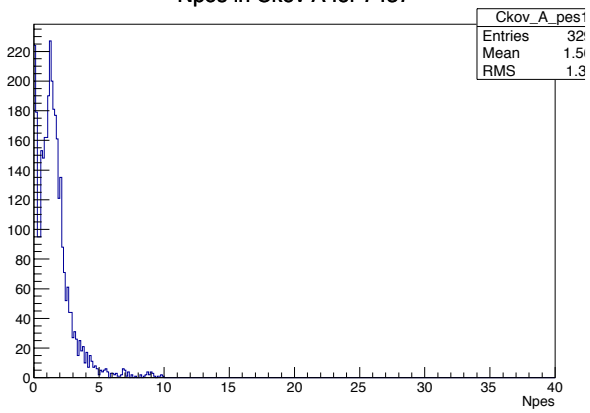
Ckov B

The data filter/cuts – Filter out PID and cut pes noise

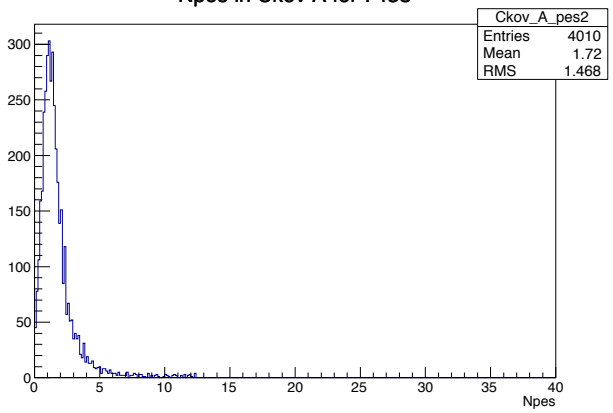
Npes in Ckov A for 7436



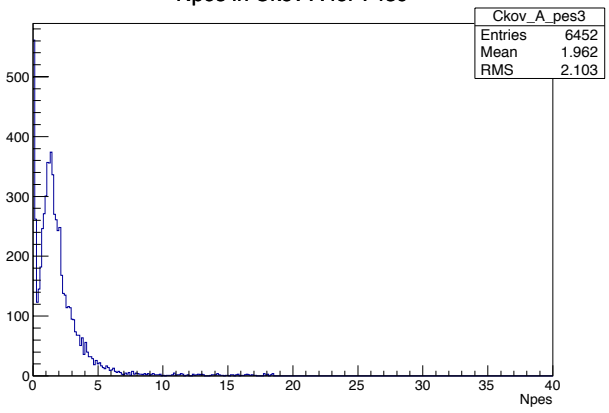
Npes in Ckov A for 7437



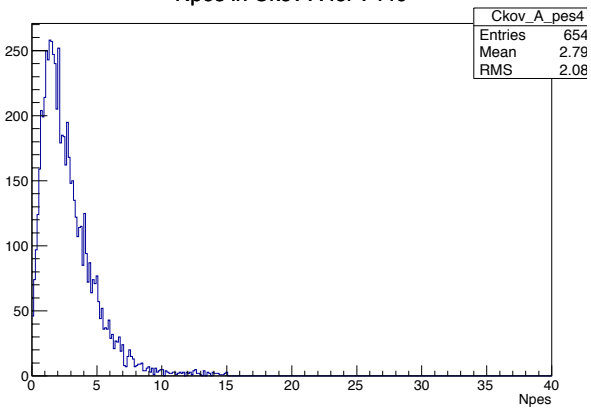
Npes in Ckov A for 7438



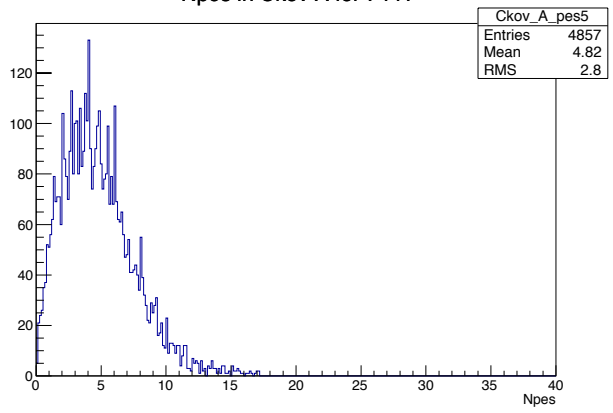
Npes in Ckov A for 7439



Npes in Ckov A for 7440



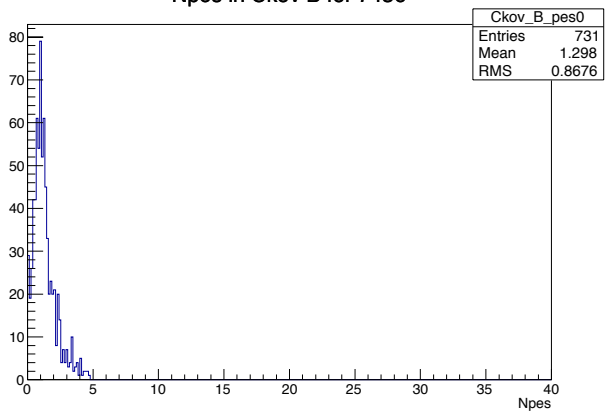
Npes in Ckov A for 7441



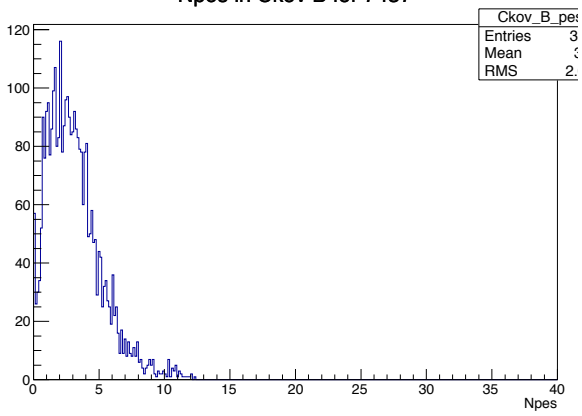
Ckov A

The data filter/cuts – Filter out PID and cut pes noise

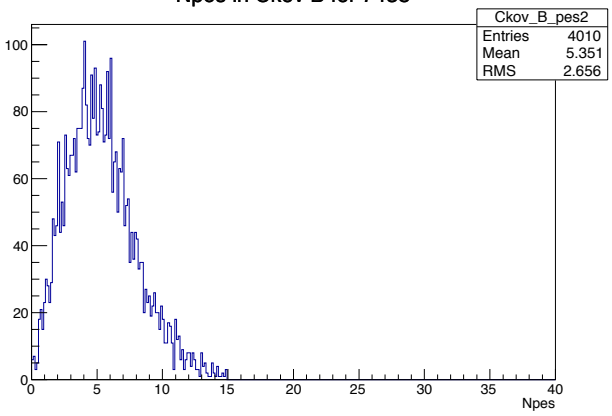
Npes in Ckov B for 7436



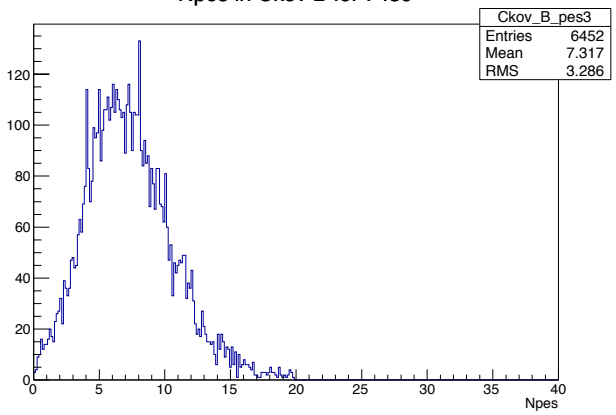
Npes in Ckov B for 7437



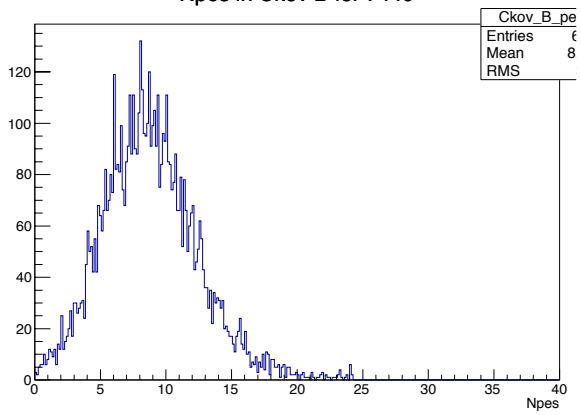
Npes in Ckov B for 7438



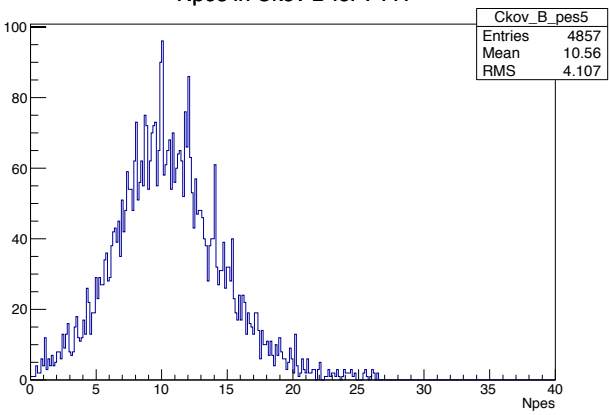
Npes in Ckov B for 7439



Npes in Ckov B for 7440



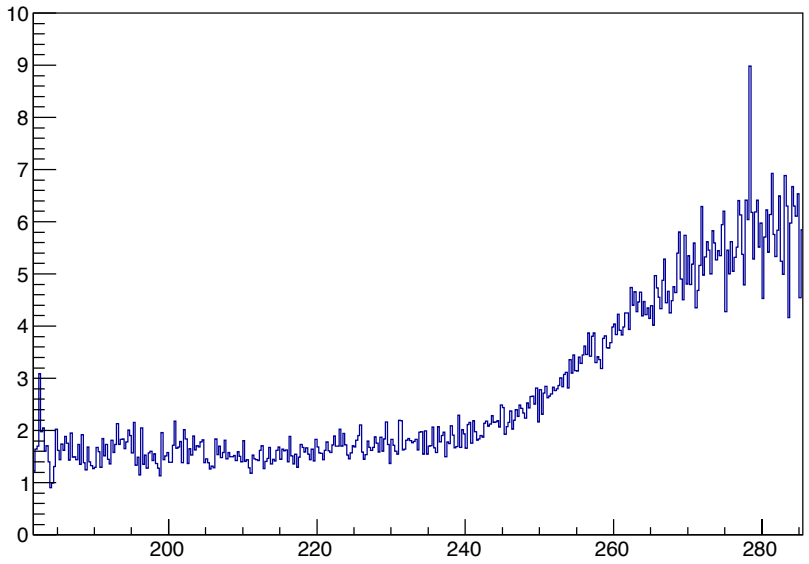
Npes in Ckov B for 7441



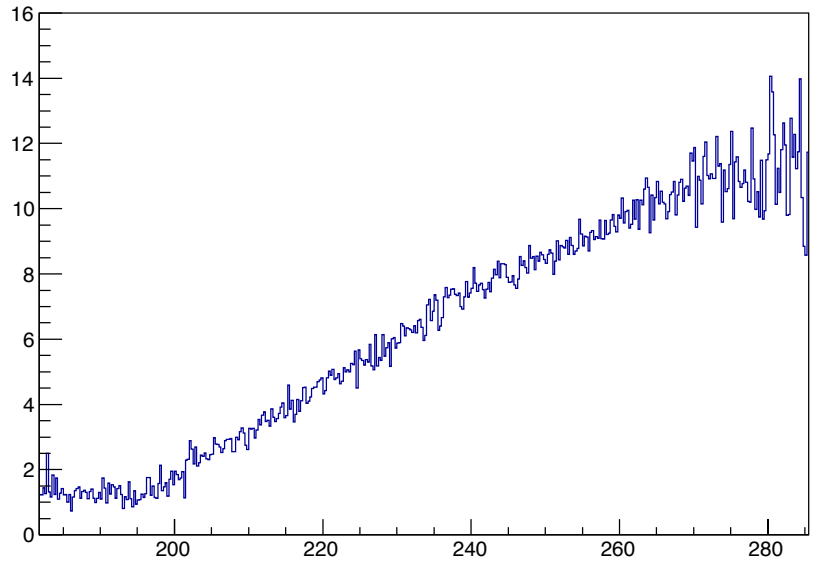
Ckov B

The data filter/cuts – Summarize all runs

Avrg_#_of_CkovA_pes_v.s._momentum_PID=13



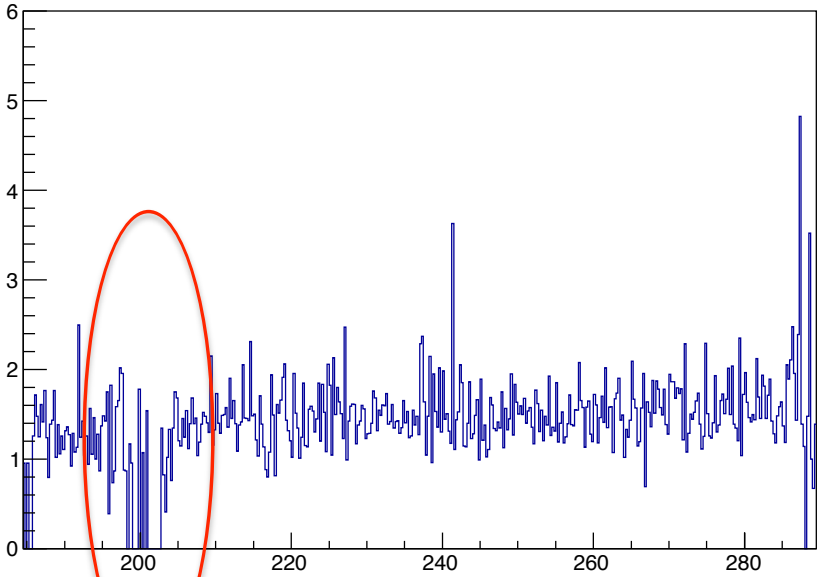
Avrg_#_of_CkovB_pes_v.s._momentum_PID=13



Get the average # of pes yield for each momentum

pes yield v.s. momentum: pions

Avrg_#_of_CkovA_pes_v.s._momentum_PID=211



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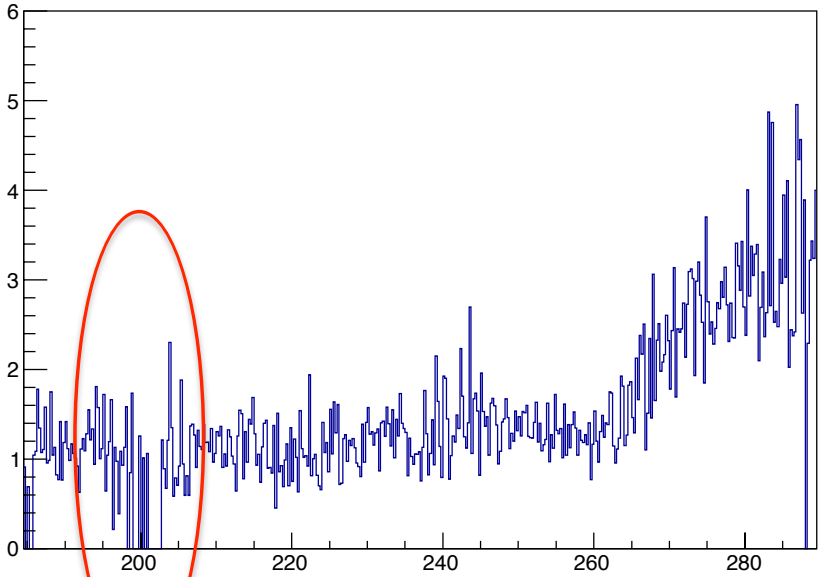

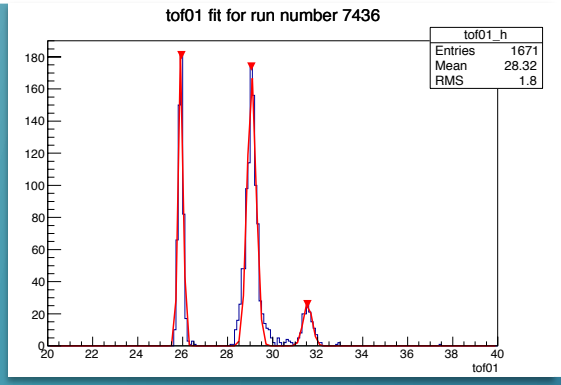

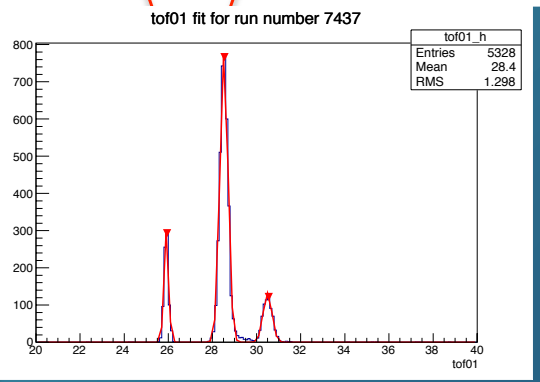

Very low statistics at tof01 ~ 31 ns corresponding P: 201.5 MeV/c

Questions and plans

- Turn-on momentum for the two detectors are inconsistent with the values in Note 473
  - This analysis: muons:
    - CkovA: ~240 MeV/c; CkovB: ~195 MeV/c
  - *Note 473 muons:*
    - *CkovA: ~280.5 MeV/c; CkovB: ~217.9 MeV/c*
  - This analysis: pions:
    - CkovA: N.A. ; CkovB: ~260 MeV/c
  - *Note 473 pions:*
    - *CkovA: 367.9 MeV/c; CkovB: 285.8 MeV/c*
- Chances are that the aerogel has different refractive index now than that time.

Questions and plans

- Double-checked the distance between TOF0 and TOF1 from the current Geometry ID=70
  - 12929.4404, 5285.6644 mm were used in the analysis code.
- TOF1 was moved since the last Ckov analysis
  - 7862 mm between TOF0 and TOF1
  - ID=47
- Plan: Use the code to re-analyze the data taken in spring 2015.
  - Need: reconstructed data with the current data structure. (A collaboration work with Durga)